

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	TITLE PAGE	i
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF SYMBOLS	xiv
	LIST OF ABBREVIATIONS	xv
	LIST OF APPENDICES	xvii
I	INTRODUCTION	1
	1.1 General	1
	1.2 Background of Study	3
	1.3 Statement of Problem	4
	1.4 Research Methodology	5
	1.5 Research Scope	6
	1.6 Significance of Study	6
	1.7 Objective of Study	7

II	LITERATURE REVIEW	8
2.1	Solid Waste Generation in Malaysia	8
2.2	Municipal Solid Waste (MSW)	10
2.3	Types of Municipal Solid Waste	11
2.3.1	Non-Hazardous Municipal Solid Waste (NHMSW)	12
2.3.2	Hazardous Municipal Solid Waste (HMSW)	13
2.4	Solid Waste Management (SWM)	14
2.5	Components of SWM	16
2.5.1	Waste Generation	17
2.5.2	Storage	17
2.5.3	Collection	18
2.5.4	Transfer and Transport	18
2.5.5	Processing and Recovery	19
2.5.6	Disposal	19
2.6	Background of Cadmium (Cd)	20
2.7	Background of Nickel (Ni)	21
2.8	Nickel-Cadmium (Ni-Cd) Batteries	22
2.8.1	End-of-Life of Ni-Cd Batteries	24
2.8.2	Potential Health Effects of Ni-Cd Batteries	25
2.8.3	Collection and Recycling of Spent Ni-Cd Batteries	26
2.8.3.1	Curb side Recycling program	28
2.8.3.2	Battery Drop-off Collection sites	29
2.8.3.3	Point-Of-Sale Sites	30
2.9	Collection and Recycling of Spent Ni-Cd Batteries in Some Developed Countries	31
2.9.1	Collection and Recycling of Spent Ni-Cd Batteries in the United States	31
2.9.2	Collection and Recycling of Spent Ni-Cd Batteries in Japan	33
2.10	Study Area	35
2.11	Public Awareness	37

2.11.1	Department of Environment (DOE)	39
2.11.2	Participation of the Generating Public	40
2.12	Private Sector Involvement	41
2.12.1	Formal Private Sector	42
2.12.1.1	Potential Benefits of the Formal Private Sector	42
2.12.2	Informal Private Sector	43
2.12.2.1	Potential Benefits of the Informal Private Sector	44
2.13	Non-Governmental Organizations (NGOs)	45
2.14	Community Based Organizations (CBOs)	45
III	METHODOLOGY	47
3.1	Introduction	48
3.2	Data Collection	48
3.3	Questionnaire	48
3.4	Interviews	49
3.5	Data Analysis	50
3.6	Frequency Analysis	51
3.7	Qualitative Analysis	51
3.8	Expected Findings	51
IV	DATA COLLECTION AND ANALYSIS OF RESULT	52
4.1	Introduction	52
4.2	Data Collection	53
4.2.1	Interview Data Collection	53
4.2.1.1	Interview at DOE	54
4.2.2	Questionnaire (Descriptive Analysis)	56
4.2.2.1	Solid Waste Management of the Study Area	60
4.2.2.2	Awareness of Recycling Spent Ni-Cd rechargeable Batteries	63

	4.2.2.3 Willingness to Recycle Spent Ni-Cd rechargeable Batteries	68
4.3	Inferential Analysis	71
4.3.1	Bivariate	71
	4.3.1.1 Gender of Respondents	71
	4.3.1.2 Level of Education	72
	4.3.1.3 Level of Income	73
4.3.2	Linear Regression	75
	4.3.2.1 Knowledge of Recycling Ni-Cd Rechargeable Batteries	75
	4.3.2.2 The Need to Recycle Ni-Cd Rechargeable Batteries	76
	4.3.2.3 Community Involvement and Participation in Recycling Ni-Cd Batteries	76
V	CONCLUSION AND RECOMMENDATIONS	78
5.1	Conclusion	78
	5.1.1 Evaluation of the Awareness of Recycling Spent Ni-Cd Batteries	79
	5.1.2 Assessment of Public Concern on Recycling of Waste Ni-Cd Batteries	79
	5.1.3 Evaluation of the Willingness to Recycle Spent Ni-Cd Batteries from MSW Stream	80
5.2	Recommendations	80
	REFERENCES	82
	APPENDICES	87-104

LIST OF TABLES

TABLE NO.	TITLE	PAGE
2.1	MSW generated in all states of Malaysia	10
2.2	Sources and types of municipal solid waste	11
2.3	HMSW and its effects	14
2.4	Designated Markings on Batteries	34
3.1	Sections of the Questionnaire	49
3.2	Questionnaire scale	50
4.1	Number of questionnaire returned	56
4.2	Frequency distribution of gender	57
4.3	Forms of occupation (Employment type)	59
4.4	Frequency distribution of respondents towards solid waste management	61
4.5	Frequency distribution of respondents to knowledge of recycling	61
4.6	Frequency distribution towards participation in source recycling	61
4.7	Frequency distribution on willingness to pay for solid waste management	63
4.8	Awareness to recycle Ni-cd batteries	65
4.9	Correlation data of Gender and Dependent Variables	72
4.10	Correlation of the Level of Income	74

LIST OF FIGURES

FIGURE NO	TITLE	PAGE
2.1	General Flow of Materials and the Generation of Solid Waste in a Society	9
2.2	Hierarchy of ISWM	15
2.3	The Interrelationship of the Six Functional Elements of SWM	16
2.4	Schematic Drawing of a Typical Cylindrical Ni-Cd Battery	24
2.5	Typical End-of-Life of Ni-Cd Batteries	25
2.6	Typical Curb-side Collection System	29
2.7	Typical Example of Battery Collection Site in Malaysia	30
2.8	Arial View of Study Area	36
2.9	Awareness Programme to Recycle in Schools	38
4.1	Showing the Range of Age Groups	57
4.2	Distribution of the Level of Education	58
4.3	Level of Income	59
4.4	Comparing the Income Groups with Solid Waste Management Affirmation	62
4.5	Frequency and Percentage of Respondents with the Knowledge of Ni-Cd Batteries	64
4.6	Percentage of Respondents with Knowledge of Ni-Cd Batteries Hazardous Content	64
4.7	Age Comparism with Knowledge of Ni-Cd Batteries	65
4.8	Income Level in Relation to Age Groups	66
4.9	Income Level Compared with Knowledge of Recycling	66

4.10	Comparing Income with Participation in Source Separation	67
4.11	Income with Recycling Knowledge of Ni-Cd Battery	67
4.12	Percentage of Respondents Requiring Responsible Authority Intervention	69
4.13	Percentage Distribution of Respondents Willing to Enrol for Community Participation	69
4.14	Concern to Recycle Ni-Cd Battery Compared with Income Level	70
4.15	Income Level in Relation to Community Participation in Source Separation of Spent Ni-Cd Battery	70

LIST OF SYMBOLS

Ca	-	Calcium
Cp	-	Community Participation
Fe	-	Iron
G	-	Gender
I	-	Income level of respondent
Kb	-	Knowledge of recycling Ni-Cd batteries
Kg	-	Kilograms
Mg	-	Magnesium
mg	-	milligrams
Nr	-	Need to Recycle
O	-	Occupation
O ₂	-	Oxygen
P	-	Level of Significance
r	-	Pearson Correlation
Zn	-	Zinc

LIST OF ABBREVIATIONS

Att_Prog	-	Attendance of Awareness Programmes
Awr_ccentrr	-	Awareness of Collection Centre
Awr_prog	-	Awareness Programmes
CBOs	-	Community Based Organizations
Cc_disposal	-	Disposal at Collection Centre
DOE	-	Department of Environment
EPA	-	Environmental Protection Agency
EQA	-	Environmental Quality Act
HMSW	-	Hazardous Municipal Solid waste
HSW	-	Hazardous Solid Waste
HW	-	Hazardous Waste
ISWM	-	Integrated Solid Waste Management
JBRC	-	Japan Rechargeable Battery Recycling Centre
Knwl_recycl	-	Knowledge of recycling
LA's	-	Local Authorities
Levl_att	-	Level of Attendance
Li-ion	-	Lithium ion
MHLG	-	Ministry of Housing and Local Government
MSW	-	Municipal Solid Waste
MSWM	-	Municipal Solid Waste Management
Need_recycl	-	Need to Recycle
NGO's	-	Non Governmental Organizations
NiCd_batt	-	Nickel-Cadmium Battery
NiCd_recycl	-	Nickel-Cadmium Recycling
Ni-MH	-	Nickel Metal Hydride

NHMSW	-	Non Hazardous Municipal Solid Waste
UK	-	United Kingdom
Ni-Cd	-	Nickel-Cadmium
PRBA	-	Portable Rechargeable Battery Association
PVC	-	Poly-Vinyl Chloride
RBRC	-	Rechargeable Battery Recycling Centre
RCRA	-	Resource Conservation and Recovery Act
RD	-	Residual Debris
RWM	-	Residual Waste Material
SLA	-	Small Lead Acid
SSLA	-	Small Sealed Lead Acid
S_waste	-	Solid Waste Management (collection)
SW	-	Solid Waste
SWM	-	Solid Waste Management
UNEP	-	United Nation Environmental Protection
US	-	United States
WHO	-	World Health Organization

LIST OF APPENDICES

APPENDIX NO	TITLE	PAGE
3.1	Interview Questions with the DOE	87
3.2	Household Questionnaire Distributed (English)	88
3.3	Household Questionnaire Distributed (Malay)	92
4.1	Summary of Statistical Data from Household Questionnaire	96
4.2	Regression Tables for Dependent Variable Ni-Cd Recycle	99
4.3	Regression Tables for Dependent Variable Need_Recycle	101
4.4	Regression Tables for Dependent Variable Community	103